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(54) **Rolling bearing unit with rotational speed sensor**

Kugellager mit Drehzahlsensor

Roulement à billes combiné avec capteur tachymétrique

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**US-A- 5 550 467**

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## Description

### Field of the Invention

[0001] The present invention is related to a rolling bearing unit with a rotational speed sensor, which is utilized to rotatably support a road wheel with reference to a suspension apparatus while detecting the rotational speed of the road wheel.

[0002] The road wheel is rotatably supported by a rolling bearing unit with reference to a suspension apparatus. In addition, the rotational speed of the road wheel must be detected in order to control an anti-lock braking system (ABS) and traction control system (TCS). Accordingly, recently the rolling bearing unit with rotational speed sensor, that is the rolling bearing unit having a rotational speed sensor installed therein, is broadly used to rotatably support the road wheel while detecting the rotational speed of the road wheel.

[0003] Japanese Utility Model Publication JITSUKAI HEI No. 7-31539 discloses one example of the prior art structures of the rotational speed sensor, which is also referred to as rpm detector in this specification, for use in such an object.

[0004] In this structure, a pair of bolts and nuts 12, 13 are used to securely fix a sensor 10 to a cover 9 of the rolling bearing unit (see e.g. Fig. 3 of the publication). This step is carried out in the assembling site of the rolling bearing unit with rotational speed sensor but inconvenient to need a long process time. In addition, the disengagement and engagement of the bolts and nuts for repairing the rotational speed sensor in the rolling bearing unit are also troublesome. This leads to cost-up in the production and repair.

[0005] U.S. Patent No. 4,946,295 discloses another example of the bearing unit with rpm detector where the sensor is easily engaged and disengaged with and from the bearing unit for easy inspection and repair. No special tool is used to install the sensor at the end of the stationary outer ring. However, no seal device is installed in this structure to protect the encoder and sensor from outside. Specifically, the seal ring 10 in this structure is used for isolating the space for installing the rolling members 3 from outside, but not for isolating the encoder and sensor from outside. Accordingly, for example, when it rained, water drops may be kept attached to the clearance between the encoder 19 and sensor 8, which may lead to damages of the encoder and/or sensor if the automobile is started with the attached water drops frozen.

[0006] JP Patent Publication TOKUKAI HEI No. 9-1964945 discloses another example of the bearing unit with rpm detector, where the holder 26 with the sensor 12a embedded therein can be easily installed and removed with respect to the cover 23 fixed to the outer ring 2a without any special tool. However, some improvements are required in assembling the bearing unit with rpm detector. Specifically the cylindrical support

body 27 must be placed in alignment with the holder 26. in phase in a circumferential direction. Therefore, the holder must often be rotated inside the cylindrical support body, but due to the presence of the elastically compressed O-ring on the cylindrical support body, the force to rotate the holder is substantially large to easily worsen the assembly performance of the bearing unit with rpm detector. In addition to the assembly performance, the performance of the rotational speed sensor must be taken into consideration with respect to the installation of the holder into the cover of the bearing unit.

[0007] The mechanism of the rotational speed sensor is detailed later referring to Figs. 22 to 25.

[0008] US Patent No. 5,550,467 discloses a device for measuring rotation which is mounted into a wheel bearing. The device comprises a sensor including a cylindrical housing which is mounted in a grease cap coupled to a stationary outer ring of a wheel bearing. The sensor is mounted on the central axis of the bearing and is held in a predetermined angular position by a detent which engages a recess in a mounting support of the grease cap. The sensor is plugged into the mounting support during fitting to the cover, and is located within a signal-generator component part which includes a signal generator ring coupled to a rotating inner ring of the bearing. The signal generator ring rotates around the sensor in use.

[0009] US Patent No. 5,544,962 discloses a wheel bearing unit for an automotive vehicle. The bearing unit is of a similar structure to the device of US 5,550,467. However, the wheel bearing of US 5,544,962 has a sensor which faces a pulse generator ring coupled to a rotating inner ring of the bearing. The sensor is mounted in a plastic housing which is coupled to a stationary outer ring of the bearing.

[0010] European Patent Publication No. 0092605 discloses a bar-type sensor for measuring rotational speed of vehicle wheels. The sensor is held opposite a rotor in a clamping bush mounted in a bore of a brake supporting plate. A spring exerts a spring force on the sensor which prevents the sensor from coming out of the bush in the event that the sensor experiences high frequency vibrations.

[0011] French Patent Publication No. 2678063 discloses a fixing device for fixing a sensor in the bore of a support such as an air intake ducting of a motor vehicle. The fixing device includes a flat washer with internal and external discontinuous skirts formed by a series of fins. The internal skirt resiliently engages the sensor and the sensor is then located in the support, where the external skirt bends resiliently to hold the sensor in the support.

[0012] The applicant's earlier US Patent No. 5,148,104 discloses a hub unit for sensing rotational speed installed in a built-in ABS or TCS to sense the speed of rotation of the wheels. The hub unit includes a sensor which is offset from a main axis of the hub, for measuring rotation of a pulse rotor coupled to the rotary

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hub.

### Summary of the Invention

[0013] An object of the present invention is to provide a rolling bearing unit with rotational speed sensor in which the engagement and disengagement of the sensor to the cover is carried out easily and instantly to reduce the cost.

[0014] Another object of the present invention is to provide a rolling bearing unit with rotational speed sensor in which the sensor holder is sealingly mounted to the cover of the bearing unit with the assembly performance of the holder into the cover improved.

[0015] Accordingly, the present invention provides a rolling bearing unit as claimed in the attached claim.

### Brief Description of the Drawings

[0016]

Fig. 1 is a cross-sectional view of a rolling bearing unit.

Fig. 2 is a perspective view of the cover used in the rolling bearing unit of Fig. 1.

Fig. 3 is a perspective view of the end portion of the harness and the sensor unit used in the rolling bearing of Fig. 1.

Fig. 4 is a cross-sectional view of the portion IV in Fig. 1.

Fig. 5 is a perspective view of a coupling spring to connect the sensor unit and the cover.

Fig. 6 is a cross-sectional view of the axially inner portion of the rolling bearing to show another example.

Fig. 7 is a perspective view of the cover of Fig. 6.

Fig. 8 is a perspective view of the end portion of the harness and the sensor unit used in the rolling bearing of Fig. 1.

Fig. 9 is a perspective view of one of a pair of coupling springs in Fig. 7.

Fig. 10 is an enlarged perspective view of the coupling portion between the cover and the sensor unit of Fig. 7.

Fig. 11 is a cross-sectional view of a rolling bearing unit in accordance with an embodiment of the present invention, corresponding to the right portion of Fig. 1.

Fig. 12 is a perspective view of the holder to be installed in Fig. 11.

Fig. 13 is a perspective view of the cover to be used in Fig. 11.

Fig. 14 is an end view of the cylindrical support member used in Fig. 11.

Fig. 15 is a perspective view of the cylindrical support member of Fig. 11.

Fig. 16 is a perspective view of the holder taken on the opposite side of Fig. 12.

Fig. 17 is a perspective view of the holder in another example of the present invention.

Fig. 18 is cross-sectional view of another embodiment corresponding to the right portion of Fig. 1.

Fig. 19 is a perspective view of the holder to be installed in Fig. 11.

Fig. 20 is a perspective view of the cover to be used in Fig. 11.

Fig. 21 is an end view of the cylindrical support member used in Fig. 11.

Fig. 22 is a diagrammatic view of a basic structure of the rotational speed sensor.

Fig. 23 is a diagrammatic view of a basic structure of the rotational speed sensor.

Fig. 24 is a graph showing a signal output from a pair of Hall elements of the sensor.

Fig. 25 is a graph showing a synthetic sensor output signal of the signals from the Hall elements.

Figs. 1 thru 5 show a rolling bearing unit.

[0017] The rolling bearing unit with a rotational speed sensor comprises a stationary outer ring 1 having a sensor unit 39 supported thereby and a hub 2 rotatably supported by and within the outer ring 1. The hub 2 has an encoder 3 fixed thereto, the rotational speed of which is detected by the sensor unit 39 supported by the outer ring 1.

[0018] The stationary outer ring 1 has an inner peripheral surface formed with outer ring raceways 5 in double rows, while the rotatable hub 2 has an outer peripheral surface on which a first inner ring raceway 8a is formed. Fitted onto the hub 2 and fixed with a nut 6 to form a rotatable ring assembly together with the hub 2 is an inner ring 7 which is formed with a second inner ring raceway 8b.

[0019] A plurality of rolling members 9 are provided between the first and second inner ring raceways 8a, 8b and the outer ring raceways 5 and rotatably supported by a cage 10 in each row, so that the hub 2 and inner ring 7 are rotatably supported within the outer ring 1.

[0020] Provided on the axially outer end portion of the hub 2 at a portion projected from the axially outer end of the outer ring 1 is a flange 11 to which a road wheel (not shown) is mounted. The term "axially outer" means the widthwise outer side when installed in the automobile and left in Fig. 1.

[0021] Provided on the axially inner end portion of the outer ring 1 is a mount portion through which the outer ring 1 is mounted to a suspension apparatus (not shown). The term "axially inner" means the widthwise central side when installed in the automobile, and right in Fig. 1.

[0022] A seal ring 13 is used to cover a space between the axially open end portion of the outer ring 1 and the outer peripheral surface at an axially intermediate portion of the hub 2.

[0023] Although the rolling bearing unit illustrated is of the ball bearing type, the tapered roller type can be

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used for the heavy vehicles.

**[0024]** Fitted onto the outer peripheral surface of the axially inner end portion of the inner ring 7 at a portion separated from the inner ring raceway 8b is the encoder 3 which is made of a magnetic metal plate such as carbon steel and formed in a generally annular shape in L-shaped cross-section by way of a plastic process.

**[0025]** The opening on the axially inner end (right end in Fig. 1) of the stationary outer ring 1 is covered by a cover 18. This cover 18 comprises a main body 28, which is cylindrical and has a bottom and is made by injection molding using synthetic resin, and a cylindrical body 29 that connects through fitting to the open end of the main body 28. This cylindrical body 29 is made by plastic molding of anti-corrosive sheet metal such as stainless steel, and formed into a generally circular ring shape having an L-shaped cross-section. The cylindrical body 29 has a cylindrical section 30 for fitting, and an inward facing flanged portion or brim portion 31 that bends from the base end edge of the cylindrical section 30 (right edge in Fig. 1) inward in the radial direction. By molding this inward facing flanged portion 31 into the main body 28 when performing injection molding of the main body 28, it is possible to join this cylindrical body 29 to the opening portion of the main body 28.

**[0026]** Several through holes 32 are formed around this inward facing flanged portion 31 intermittently in the circumferential direction. When performing injection molding of the main body 28, the synthetic resin used in the injection molding flows into these through holes 32, and strengthens the bond between the main body 28 and the cylindrical body 29.

**[0027]** The cylindrical section 30 of the cylindrical body 29 of the cover 18, constructed as described above, is fixed to the axially inner end portion of the outer ring 1 by way of interference fitting, so that the cover 18 covers the opening at the axially inner end of the outer ring 1. Moreover, in this condition, the end surface of the opening portion of the main body 28, or in other words, the end surface of the cylindrical wall 36 around the outer peripheral edge of the main body 28, comes into contact with the axially inner end surface of the outer ring 1. A groove is formed all the way around the end surface of the cylindrical wall 36, and an O-ring 33 is fastened inside this groove. When the end surface of the cylindrical wall 36 is in contact with the axially inner end surface of the outer ring 1, the O-ring 33 is elastically compressed between this axially inner surface of the outer ring 1 and the bottom of the groove in the cylindrical wall 36 and seals the connection between the cover 18 and outer ring 1 to prevent foreign matter, such as muddy water, from getting inside the cover 18.

**[0028]** On the other hand, the encoder 3 fits around the axially inner end (right end in Fig. 1) of the inner ring 7, which together with the hub 2, forms the rotating ring assembly. This encoder 3 comprises a support ring 34 and permanent magnet 35. Of these, the support ring 34 is formed into a circular-ring shape having an L-

shaped cross section by bending magnetic sheet metal such as SPCC, and is attached to the axially inner end of the inner ring 7 by way of interference fitting. Moreover, the permanent magnet 35 is formed by providing e.g. through molding the axially inner surface of the support ring 34 with a rubber that is impregnated with ferrite power or the like. This permanent magnet 35 is magnetized along the axial direction (left and right in Fig. 1), such that the polarity alternates at equal intervals around in the circumferential direction. Accordingly, the South and North poles alternate at equal intervals in the circumferential direction on the axially inner surface of the encoder 3.

**[0029]** Moreover, in part of the bottom plate 37 of the main body 28 which forms the cover 18, an insert hole 38 is formed in the section which faces the axially inner surface of the permanent magnet 35 of the encoder 3, and it passes through the bottom plate 37 along the axial direction of the outer ring 1. The tip end portion of the sensor unit 39 is inserted in this insert hole 38. The sensor unit 39 corresponds to a sensor or a holder which holds the sensor. This sensor unit 39 comprises a magnet detection element, such as a Hall element or magnet resistance element (MR element), whose characteristics change according to the direction of the flowing magnetic flux, an IC which contains a wave shaping circuit for shaping the output wave of the magnet detection element, and a magnetic pole piece for guiding the magnetic flux from the permanent magnet 35 (or that is flowing through the permanent magnet 35) to the magnet detection element, all of which are embedded in synthetic resin. Also, a harness 46 is provided so that the signal output as a shaped wave form from the IC is sent to the controller (not shown in the figure), and the end of the harness 46 is connected directly to the sensor unit 39 with no connector used. Accordingly, it is possible to reduce the cost of a rolling bearing unit with rpm detector, by the cost of the connector omitted.

**[0030]** This kind of sensor unit 39 has a circular column-shaped insert section 40 which is located on a portion closer to the tip end (left end in Fig. 1) of the sensor unit 39, and an outward facing, flange-shaped rim portion 41. The insert section 41 can be inserted freely without any play, into the insert hole 38, and the rim portion 41 is used for positioning and formed on the base end (right end in Fig. 1) of this insert section 40. A groove for engagement is formed around the outer surface in the middle of the insert section 40, and an O-ring 42 is fastened in that groove. When the insert section 40 is inserted through the insert hole 38, the O-ring 42 is elastically compressed between the inner peripheral surface of the insert hole 38 and the bottom of the groove, forming a seal between the outer peripheral surface of the insert section 40 and the inner peripheral surface of the insert hole 38. In other words, the O-ring 42 prevents foreign matter, such as muddy water, from passing through the insert hole 38 to get inside the cover 18 and outer ring 1. In this way, the joint between the stationary

ring or outer ring 1 and cover 18 is sealed by O-ring 33, and the inserted section of the sensor unit 39 onto the cover 18 is sealed by O-ring 42, so as to prevent foreign matter from getting into the rolling-bearing unit, making it possible to secure the durability of the rolling-bearing unit, prevent foreign matter, such as magnetic powder, from adhering to the sides of the permanent magnet 35 which forms the encoder 3, and maintain the accuracy of the rpm detection. If an X-ring, which has an X-shaped cross section, or any other seal ring is used in the place of the O-ring as a seal ring for sealing the inserted section of the sensor unit 39 into the cover 18, it is possible to reduce the force required for inserting the insert section 40 of the sensor unit 39 into the insert hole 38, thus making installation of the sensor unit 39 easier.

[0031] On the other hand, on part of the outside surface of the bottom plate 37 of the cover 18 (right side in Fig. 1, and the side surface, opposite to the space 43 where the rolling bodies 9 are located, and which should be covered by the cover 18), a cylindrical body 44 for engagement is formed in the area that surrounds the opening of the insert hole 38. The inner peripheral surface of this cylindrical body 44 forms a single cylindrical surface together with the inner peripheral surface of the insert hole 38. Moreover, in this embodiment, the side surface on the end of the opening portion of the cylindrical body 44 corresponds to the edge around the opening of the insert hole 38. Also, on the outer peripheral surface of the cylindrical body 44, concave sections 45 are formed in two locations on opposite sides in the diametrical direction. These concave sections are sufficiently wider than the outer diameter of the wire material of the coupling spring 47 (described later). On one side of each concave section 45 specifically on the inside surface closer to the end of the cylindrical body 44 (right side in Fig. 4), a groove 48 is formed in an arc-shaped cross section along the entire width of the concave sections 45. The radius of curvature of these grooves 48 is the same as or a little larger than the radius of curvature of the outer peripheral surface of the wire material that forms the coupling spring 47.

[0032] The flanged portion or rim portion 41, which is formed at the base of the sensor unit 39 and which acts as a positioning unit, comes in contact with the side surface on the end (right end in Fig. 1) of the cylindrical body 44 that is formed as described above, and is fastened to the cylindrical body 44 by a coupling spring 47 (described later). This spring 47 is made of stainless spring steel, or spring steel that has been treated with chrome or zinc plate, or another wire material that is elastic and rust proof and formed by bending process. If a wire material is used that has been plated, it is dehydrogenated to prevent delayed failure. This spring 47 comprises a pair of legs 49 for engagement, a retainer section 50 and a pair of connection sections 51. The pair of legs 49 become parallel to each other when installed in the cylindrical body 44. The retainer section 50 is provided for retaining the flanged portion 41 to the end sur-

face of the cylindrical body 44, and the pair of connection sections 51 is provided to connect both ends of the retainer 50 to the base (upper right end in Fig. 5) of the legs 49. The retainer section 50 has a U-shaped curved portion 52 in the center, and a pair of straight portions 53 bent in opposite directions from both ends of the curved portion 52. The connection sections 51 are bent at one end thereof in the same direction from these straight portions 53.

[0033] When using this kind of coupling spring 47, the plane which includes the pair of legs 49 is parallel to the plane which includes the retainer 50, at least during use. However, an elastic force is applied in the direction which decreases the angle of the transition portion where one end of the connection section 51 connects with the base of the legs 49 in order to reduce the space between these planes when this coupling spring 47 is free. Moreover, the space  $D_{49}$  (see Fig. 5) between the main portions of legs 49 becomes less than the space  $D_{45}$  (see Fig. 4) between the concave sections 45. That is  $D_{49} < D_{45}$ . Furthermore, the tip ends of both legs 49 are bent outward in opposite directions, and the space between at the ends of both legs becomes larger in the direction toward the tip end of the legs 49. In other words, the closer to the tip end of the legs 49 the larger the space between the legs 49 is.

[0034] On the other hand, a groove 54 for retaining the spring 47 is formed in the base end face of the flanged portion 41 formed around the sensor unit 39 (surface opposite the insert section 40, surface on the right end in Fig. 1, and the surface in the front in Fig. 3) so that the retainer section 50 of the spring 47 fits firmly without play in the groove 54. This groove 54 comprises a curved or bent section 55 which goes around the base end of the harness 46, and straight sections 56 that are bent outward from the opposite ends of the curved section 55 in opposite directions and open to the outer peripheral edge of the flanged portion 41. Moreover, an inclined surface 57 is formed on part of the base end face of the flanged portion 41 which faces the convex side of the curved section 55. This inclined plane 57 slants in a direction such that the thickness of the flanged portion 41 becomes thinner in the direction toward the edge of the flanged portion 41. In other words, the closer to the peripheral edge of the flanged portion 41 the thinner the thickness of the flanged portion 41.

[0035] The work to install the sensor unit 39 and attach it to the cover 18 when combining each member described above to construct the rolling-bearing unit with rpm detector, is performed as follows. First, the insert section 40 closer to the tip end of the sensor unit 39 is inserted into the cylindrical body 44 and into the insert hole 38 until the flanged portion 41 comes in contact with the tip end surface of the cylindrical body 44. The dimension of each part is regulated so that a small clearance of desired width (for example 0.5mm) exists between the detection section on the end surface of the insert section 40 of the sensor unit 39 and the axially

inner surface of the permanent magnet 35 of the encoder 3. Next, the coupling spring 47 is placed between the cylindrical body 44 of the cover 18 and the sensor unit 39 to press the flanged portion 41 against the tip end surface of the cylindrical body 44.

[0036] The work of installing the coupling spring 47 between the cylindrical body 44 of the cover 18 and the sensor unit 39 is performed by inserting first the ends of and then the main portion of the pair of legs 49 of the spring 47 into the concave sections 45 of the cylindrical body 44. The space between the ends of both of these legs 49 becomes larger toward the tip end, so that the insertion process is simple. As the legs 49 are inserted, the straight sections 53 of the retainer section 50 moves over the inclined plane 57 formed on the flanged portion 41. In this state, if insertion is continued, the retainer section 50 fits into the groove 54 formed on the base end surface of the flanged portion 41. When inserting it, the space between the pair of connection sections 51 that are nearest the retainer 50 is made a little larger than the outer diameter of the flanged portion 41, so that the parts of the pair of connection sections 51 which face the outer peripheral edge of the flanged portion 41 do not interfere with the outer peripheral edge of the flanged portion 41.

[0037] With the retainer section 50 fit into the groove 54, the coupling spring 47 press the flanged portion 41 against the end surface of the cylindrical body 44 with adequate force (for example, 10kgf), and couples the sensor unit 39 with the cover 18. Moreover, in this state, depending on the fit of the legs 49 in the grooves 48 and the fit of the retainer section 50 in the groove 54, the coupling spring 47 will not accidentally come apart from the sensor unit 39 and cylindrical body 44. As a result, the sensor unit 39 will not accidentally come apart from the cover 18.

[0038] To remove the sensor unit 39 from the cover 18, following the above procedure in the reverse order. First, the coupling spring 47 is removed from between the cover 18 and the sensor unit 39. When doing this, first the retainer section 50 is lifted from the base end surface of the flanged portion 41, then the pair of legs 49 are pulled out from the concave sections 45. After the spring 47 has been removed, the insert section 40 of the sensor unit 39 is removed from the insert hole 38 and from the inside of the cylindrical body 44.

[0039] Installing or removing the coupling spring 47 from between the cylindrical body 44 of the cover 18 and the sensor unit 39 can be performed relatively easily and quickly when compared with having to fasten and unfasten setscrews. Moreover, the amount of work required for installing or removing the sensor unit 39 from the cover 18 is reduced, and makes it possible to reduce the cost of the rolling bearing unit with rpm detector as well as reduce the cost of repair.

[0040] In the explanation above, together with making the space  $D_{49}$  between the pair of legs 49 of the coupling spring 47 in a free state smaller than the space  $D_{45}$  be-

tween the pair of concave sections 45 formed on the outer peripheral surface of the cylindrical body 44, the grooves 48 are formed in the concave portions 45. However, if the space  $D_{49}$  is smaller than the space  $D_{45}$ , the grooves 48 are not necessary. For example, as shown in Fig. 1, if the concave sections 45 are formed in a grooved shape that just allows the legs 49 to fit firmly, it is possible to prevent the legs from accidentally coming out of the concave portions 45. Conversely, if grooves 48 are formed, it is possible to prevent the legs 49 from accidentally coming out of the concave sections 45 even if the space  $D_{49}$  is not smaller than the space  $D_{45}$ . Anyhow, the shapes and dimensions shown in Figs. 4 and 5 are desirable in order to maintain adequate strength in the joint between the cover 18 and sensor unit 39 by the spring 47 and make it easier to install or remove the spring 47.

[0041] Next, an alternative rolling bearing unit is shown in Figs. 6 to 10. In this bearing unit, the sensor unit 39 is connected to the cylindrical body 44 of the cover 18 using a pair of springs 47. Therefore, two support pieces 72 in a set are formed, separated from each other, at two locations on opposite sides in the diametrical direction on the outer peripheral surface of the cylindrical body 44. These support pieces 72 are formed with an arc shape, so that the tip end or pivot supports 73 are formed on both ends of the spring 47 to be described later can be supported so they freely rock on the inside of the support pieces 72. This pair of support pieces 72 are formed on opposite sides in the circumferential direction on the outer peripheral surface of the cylindrical body 44, so that there is no interference of the springs 47 with other parts as the pair of springs 47 pivotally supported by these support pieces 72 rock.

[0042] The pair of springs 47 have a straight retainer section 50, a pair of pivot supports 73 and a pair of elastic legs 74 that are bent into a "V" shape to connect the retainer section 50 to the pair of supports 73, as shown in Fig. 9. The elastic legs 74 are elastically deformed in the direction of elongation, when a tensile force is applied, making it possible for the retainer section 50 and the supports 73 to be separated from each other. The pair of pivot supports 73 on both ends of the coupling springs 47 are orientated to conform with the support pieces 72 which support both pivot supports 73, causing the pivot supports 73 to be slanted, respectively. Moreover, the space  $D_{73}$  between the tip ends of the pair of supports 72 in a free state is sufficiently larger than the space  $D_{72}$  between the pair of pivot support pieces 73. That is  $D_{73} > D_{72}$ .

[0043] On the other hand, a pair of parallel grooves 54 are formed on the base end surface of the flanged portion 41 of the sensor unit 39 with the harness 46 located therebetween. The retainer sections 50 of the springs 47 fit firmly into these grooves 54. Moreover, on opposite sides in the radial direction of the base end surface of the flanged portion 41, inclined surfaces 57 are formed on the outer peripheral side of the grooves to-

ward the edges, such that the thickness of the flanged portion 41 becomes smaller toward the edge of the flanged portion 41 from the grooves 54.

[0044] To hold and fasten the sensor unit 39 described above inside the cylindrical body 44, first the pivot supports 73 of the pair of springs 47 are engaged with the pair of support pieces 72, respectively. This work can be easily performed in a wide space. By rocking the pair of springs 47 toward the side of the cylindrical body 44, the retainer sections 50 are moved away from the opening of the cylindrical body 44, and in the state, the insert section 40 of the sensor unit 39 is inserted into the insert hole 38 on the inside of the cylindrical body 44 until the flanged portion 41 comes in contact with the tip end surface of the cylindrical body 44. In this state, the dimensions of each part are regulated so that the minute specified space exists between the detector on the tip end surface of the insert section 40 of the sensor unit 39, and the axially inner surface of the circular ring portion 16 of the encoder 3. Next, the pair of coupling springs 47 are rocked in the direction which brings the retainer sections 50 closer to the flanged portion 41, so that the retainer sections 50 are engaged with the pair of grooves 54 formed on the base end surface of the flanged portion 41. When doing this, the elastic legs 74 will elastically stretch due to the engagement of the retainer sections 50 and the inclined surfaces 57. Also, when the retainer sections 50 are in alignment with the grooves 54, the entire length of the elastic legs 74 elastically shrinks, to keep the engagement of the retainer sections 50 and grooves 54.

[0045] The sensor unit 39 is removed from the cover 18 by following the above procedure in the reverse order. The springs 47 are rocked toward the side of the cylindrical body 44 and the retainer sections 50 of the springs 47 are removed from the grooves 54. By moving the retainer sections 50 away from the opening of the cylindrical body 44, the insert section 40 of the sensor unit 39 can be pulled out from the insert hole 38 on the inside of the cylindrical body 44.

[0046] In this example, an encoder 3, which is identical to that used in the prior construction shown in Japanese Utility Model Publication JITSUKAI HEI No. 7-31539, is fitted around the axially inner end of the inner ring 7, which together with the hub 2, makes up the rotating ring assembly. Particularly, in the construction of this example, a small-diameter stepped section 69 is formed on the part of the axially inner end of the inner ring 7 that sticks out in the axial direction from the inner-ring raceway 8, and is concentric with the inner ring 7.

[0047] Also, the cylindrical section 15 of the encoder 3 fits around the stepped section 69. The reason for forming this kind of stepped section 69 is that it is not necessary to increase the diameter of the cover 18 and that the encoder 3 faces the tip end surface of the insert section 40 of the sensor unit 39.

[0048] In other words, in order that the rolling members 9 do not come out of the inner ring raceway 8b

formed around the outer peripheral surface of the inner ring 7, even when a large thrust load or moment load is applied to the rolling-bearing unit, a shoulder 70 with adequately large outer diameter must be formed on the portion sticking out in the axial direction from the inner-ring raceway 8 on the axially inner end of the inner ring 7. On the other hand, in order to detect the rpm of the rotating ring assembly, which includes the inner ring 7, the circular portion 16 of the encoder 3 must face the tip end surface of the insert section 40. By fitting the cylindrical section 15 of the encoder 3 around the shoulder section 70 itself, the diameter of the circular portion 16 becomes larger than necessary, and thus the diameter of the cover 18 which supports the sensor unit 39 facing this circular portion 16 may become larger than necessary. Therefore, by forming a stepped section 69 as described above, and fitting the encoder 3 around this stepped section 69, it is possible to prevent the diameter of the encoder 3 and cover 18 from becoming larger than necessary, and it is possible to make a more compact rolling-bearing unit with rpm detector. Of course this construction is not limited to only this rolling bearing unit, but could be equally applied to other bearing units as well.

[0049] Furthermore, in the rolling bearing unit shown in the figures, a cylindrical section 71 is formed on the axially inner end of the hub 2, and the inner ring 7 is connected and fixed to the hub 2 by expanding through crimping outward in the radial direction the portion sticking out from the axially inner surface of the inner ring 7 on the tip end of this cylindrical section 71. By adopting this kind of construction, it is possible to reduce the cost of the rolling bearing unit when compared with the prior construction of JP Publication HEI No. 7-31539 or the first example shown in Fig. 1, by reducing number of parts and the amount of work required for assembly. When expanding the tip end of the cylindrical section 71 through crimping outward in the radial direction, force is applied outward in the radial direction to part of the inner ring 7. If this force is large, the diameter of the inner-ring raceway 8 could be changed, so as to change the preload applied to the rolling members 9. However, in this example, most of the force, resulting from expanding the tip end of the cylindrical section 71 through crimping, is received by the stepped section 69 and is not applied to the inner-ring raceway 8. Therefore, there is hardly any change in the preload. This kind of construction can be applied to other examples as well.

[0050] In this rolling bearing unit, the encoder 3 used was made of magnetic material with multiple through holes 17 in the shape of slits formed around the circular ring section 16. Also, the construction of the sensor installed in the sensor unit 39 is different than that having a permanent magnet used as the encoder. However, the construction and use of this kind of sensor, has been known previously so a detailed explanation of it will be omitted. In the case that an MR element is used in the sensor, the orientation of the MR elements must be reg-

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ulated by the relationship of the longitudinal direction of the through holes 17 (radial direction of the circular section 16). In this example, it is possible to regulate the direction of the sensor unit 39 with respect to the cover 18 by engagement between the retainer sections 50 and the grooves 54, and thus it is possible to regulate the orientation of the MR element by its relationship with the longitudinal direction of the through holes 17 without any special means for positioning.

[0051] Figs. 11 to 16 show an embodiment of the present invention, which is constructed with substantially the same members as in the first example of Figs. 1 to 5, e.g. as to the outer ring 1, cover 18 and hub 2 etc.

[0052] An encoder 3 fits around the axially inner end (right end in Fig. 11) of the inner ring 7, which together with the hub 2, forms the rotating ring. The inner ring 7 is fixed to the hub 2 by crimping radially outward the axially inside end of the hub 2 after the inner ring 7 is fitted onto the axially inside end of the hub 2. The encoder 3 is formed into a circular-ring shape having an L-shaped cross section by bending magnetic sheet metal such as SPCC, and comprises a cylindrical body 15 and a circular ring portion 16 extending radially outward from the axially inner end of the cylindrical body 15. This circular ring portion 16 is provided with a number of through holes 17 in slit shape in a radial direction with a uniform interval in a circumferential direction such that the polarity of the circular ring portion 16 alternates at equal intervals around in the circumferential direction.

[0053] Moreover, in part of the bottom plate 37 of the main body 28 which forms the cover 18, an insert hole 38 is formed in the section which faces the circular ring portion 16 of the encoder 3, and the insert hole 38 is formed in a circular cross section and provided with a groove 172.

[0054] In part of the outside surface (right surface of Fig. 11) of the bottom plate 37, a cylindrical body 44 is formed to surround the opening of the insert hole 38. The inner peripheral surface of the base half portion (right half portion in Fig. 11) of the cylindrical body 44 and the inner peripheral surface of the insert hole 38 form a single cylindrical surface.

[0055] The inner diameter of the tip half portion or larger diameter portion (right half portion in Fig. 11) of the cylindrical body 44 is larger than the inner diameter of the insert hole 38 and the base half portion of the cylindrical body 44. The larger diameter portion 155 thus formed is continued through a stepped portion 156 to a portion continued from the insert hole 38.

[0056] A holder 129 made of a synthetic resin and having a sensor embedded therein is fixedly connected to the cylindrical body 44 by way of a pair of springs 47. Therefore, at two locations opposed to each other in a diametrical direction on part of the outer peripheral surface of the cylindrical body 44, a pair of support pieces 72 are provided with a space therebetween as shown in Fig. 15. The support pieces 72, four in total, are formed in an arc shape, in which pivot supports 73 formed at

both ends of the spring 47 are pivotally supported inside the support pieces 72, respectively.

[0057] The description on Fig. 6 thru 10 can be referred to for the support pieces 72, spring 47 etc. The spring 47 used in this embodiment is the same as shown in Fig. 9 and Fig. 10.

[0058] The holder 129 corresponds to the sensor unit 39 in Fig. 8, and the descriptions on the sensor unit 39 in Fig. 8 are referred to for the present embodiment, specifically on the grooves 54, inclined surface 57 etc.

[0059] The holder 129 comprises a cylindrical insert section 40 continued from the flanged portion 41. The insert section 40 comprises a larger diameter portion 60 on the base side closer to the flanged portion 41, a smaller diameter portion 61 on the tip side distal from the flanged portion 41 and a stepped portion 168 to connect the larger and smaller diameter portions 60, 61 with each other.

[0060] The larger diameter portion 60 has a diameter so as to be inserted into the larger diameter portion 155 of the cylindrical body 44 without any play while the smaller diameter portion 61 has a diameter to be inserted into the insert hole 38 without any play.

[0061] A groove 169 is formed around the outer peripheral surface in the middle of the larger diameter portion 60 of the holder 129, and an O-ring 42 is fastened in that groove 169. The outer diameter of the O-ring 42 is larger than the inner diameter of the larger diameter portion 155 of the cylindrical body 44 in a free state where it is fitted in the groove 169. On the other hand, when the larger diameter portion 60 is inserted into the larger diameter portion 155 of the cylindrical body 44, the O-ring 42 is elastically compressed between the inner peripheral surface of the larger diameter portion 155 and the bottom of the groove 169, forming a seal between the outer surface of the holder 129 and the cover 18.

[0062] Disposed on part of the outer peripheral surface of the smaller diameter portion 61 displaced from the O-ring 42 is a protrusion 171 as shown in Fig. 12 which extends in the axial direction of the small diameter portion 61.

[0063] A single cylindrical surface is formed by the inner peripheral surface and the insert hole 38 and a portion of the inner peripheral surface of the cylindrical body 44.

[0064] Provided on the inner peripheral surface of the insert hole 38 and on part of the portion of the inner peripheral surface of the cylindrical body 44 is a groove 172 for engagement with the protrusion 171 without play, which is formed in the axial direction of the insert hole 38 and cylindrical body 44. With the engagement of the protrusion 171 with the groove 172, the holder 129 is positioned in a circumferential direction.

[0065] On the other hand, the protrusion 171 can be formed on the inner peripheral surface of the cylindrical body 44, while the groove 172 can be formed on the outer peripheral surface of the holder 129, which is in-

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versed in arrangement to the embodiment in Figs. 12 and 13.

[0066] Anyhow, by controlling the relation between the installation position of the protrusion 171 and groove 172 and the installation position of the O-ring 42, the protrusion 171 is engaged with the groove 172 before the O-ring 42 is supported between the bottom surface of the groove 169 and the inner peripheral surface of the larger diameter portion 155 of the cylindrical body 44. Accordingly, in the embodiment illustrated, with the holder 129 mounted to the cover 18, the distance  $L_1$  from the step portion 156 on the inner peripheral surface of the cylindrical body 44 to the tip end surface of the holder 129 is larger than the distance  $L_2$  from the side edge of the groove 169 with the O-ring 42 installed therein, closer to the tip end (left side edge in Fig. 11) to the axially inner surface of the flanged portion 41 of the holder 129. That is  $L_1 > L_2$ . Accordingly, in this embodiment, the holder 129 could not be inserted into the cylindrical body 44 and the insert hole 38 unless the protrusion 171 is engaged with the groove 72 before the O-ring 42 is forced into the inside of the larger diameter portion 155. Consequently, the holder 129 can positively circumferentially positioned within the insert hole 38 and the cylindrical body 44 before the O-ring 42 is held between the bottom surface of the groove 169 and the inner peripheral surface of the larger diameter portion 155. Accordingly, after O-ring 42 is held between the bottom surface of the groove 169 and the inner peripheral surface of the larger diameter portion 155 of the cylindrical body 44 and then elastically compressed, what must be done is that the holder 129 is urged to be fitted into the insert hole 38 and the cylindrical body 44. Therefore, the work to install the holder 129 in the cover 18 is efficiently carried out.

[0067] In order to support and fix the holder 129 within the cylindrical body 44, the pivot supports 73 of the spring 47 are engaged with the support pieces 72, respectively. This engagement work can be carried out at a wide space site. Then, the pair of springs 47 are rocked and displaced to a side of the cylindrical body 44, so that the retainer sections 50 of the springs 47 are retracted from the opening portion of the cylindrical body 44, and in this state, the cylindrical insert portion 40 of the holder 129 is inserted into the cylindrical body 44 and then into the insert hole 38 so as to make the flanged portion 41 come into contact with the tip end surface of the cylindrical body 44. During this process, the protrusion 171 is engaged with the groove 172 to position the holder 129 in the circumferential direction.

[0068] The dimensions of respective components are controlled such that when the flanged portion 41 is abutted to the tip end surface of the cylindrical body 44 during positioning the holder 129 in the circumferential direction, there is a small clearance with a desired size between the detecting portion on the tip end surface of the insert portion 40 and the axially inner surface of the circular ring portion 16 of the encoder 3.

[0069] There is a clearance between the step portion 168 formed in the intermediate portion of the cylindrical insert portions 40 of the holder 129, and the step portion 156 formed on the inner peripheral surface at the intermediate portion of the cylindrical body 44. Then, the pair of springs 47 are rocked for displacement so that the retainer sections 50 are moved closer to the flanged portion 41, which makes the retainer sections 50 engage with the grooves 54 formed on the base end surface of the flanged portion 41. During this, the legs 61 elastically stretch based on the engagement between the retainer sections 50 and the inclined surface 57. In the state where the retainer sections 50 are in alignment with the grooves 54, the whole length of the legs 61 is elastically shrunk to keep the engagement between the retainer sections 50 and the grooves 54.

[0070] Incidentally, based on the circumferential positioning of the holder 129 which is in turn based on the engagement between the protrusion 171 and the groove 172 the retainer sections 50 and grooves 54 are correctly controlled in phase.

[0071] In the embodiments illustrated, the flanged portion 41 of the holder 129 is abutted to the tip end surface of the cylindrical body 44, and the engagement position of the flanged portion 41 with the cylindrical body 44, specifically the position of one side face of the flanged portion 41 is used as a reference surface for die process to form the holder 129 through injection molding of synthetic resin.

[0072] There is a clearance between the step portion 168 formed in the intermediate portion of the holder 129 and the step portion 156 formed on the inner peripheral surface of the cylindrical body 44. On the contrary, it is possible to make a structure having the step portions 168, 156 engaged with each other so as to use the flanged portion 168 as a reference surface for die process to form the holder 129 by injection molding of synthetic resin. In this case, there is clearance formed between the flanged portion 41 and the tip end surface of the cylindrical body 44. Anyhow, a portion of the holder 129 separated from the tip end portion of the holder 129 is abutted to the cylindrical body 44 or the peripheral portion of the opening of the insert hole 38 so as to position the holder 129 in the axial direction (inserting direction).

[0073] On the process to remove the holder 129 from the cover 18, and on the members such as the step portion 69 formed on the axially inner end of the inner ring 7, and the cylindrical portion 71 formed on the axially inner end of the hub 2, the descriptions of the roller bearing units of Figs. 6 to 10 are referred to.

[0074] Fig. 17 shows another example of the embodiments of the present invention, where the protrusion 171 for engagement is provided in a portion of the smaller diameter portion 61 of the cylindrical insert section 40 of the holder 129, except for the tip end portion (left end portion in Fig. 17) of the smaller diameter portion 61. The position of the tip end of the protrusion 171 is controlled such that the protrusion 171 enters the groove

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172 on the cover 18 (Figs. 13 and 14) before the O-ring 42 mounted to the groove 169 enters the inside with reference to the inner peripheral surface of the cover 18. Although not illustrated, the protrusion 171 for engagement can be formed only on the tip end portion of the smaller diameter portion 61 of the cylindrical insert portion 40.

[0075] Figs. 18 to 21 show another example of the present invention, where the inner diameter of the cylindrical body 44 on the outer surface of the cover 18 is substantially the same to the inner diameter of the insert hole 38 along the substantially whole length. An outwardly flared portion 176 is formed on the peripheral portion of the opening of the cylindrical body 44, such that the O-ring 42 is elastically pressed between the outwardly flared portion 176, the outer peripheral surface of the base end of the cylindrical insert section 40 of the holder 129, and one side surface of the flanged portion 41. In this example, the outwardly flared portion 176 is a portion of the cover 18.

[0076] The protrusion 171 is engaged with the groove 172 before the O-ring 42 is held between the outer peripheral surface of the base end of the cylindrical insert section 40 and the inclined portion 176. Accordingly, the holder 129 is positively circumferentially positioned within the insert hole 38 and cylindrical body 44, which makes the installation of the holder 129 to cover 18 efficient.

[0077] The diameter of the O-ring 42 and the position of forming the groove 172 are controlled such that the location where the O-ring 42 comes into contact with the inclined portion 176 is located radially outside the opening at the end of the groove 172. Accordingly, the O-ring 42 is engaged with the inclined portion 176 throughout their periphery without any interruption. Therefore, the seal performance is never damaged on the portion where the O-ring 42 is installed on the basis of the groove 172.

[0078] If the die for injection molding the holder 129 with synthetic resin is formed in a structure which is split radially in cross section, it is possible to form, only by way of injection molding of synthetic resin, that is with no following cutting process, a structure including the protrusion 171 which extends only to the intermediate portion of the cylindrical insert section 40 as shown in Fig. 19.

[0079] Fig. 22 shows an example of the rotational speed sensor device comprising an encoder 3 having S-pole and N-pole alternately arranged, and a sensor 4 having a pair of Hall elements 140 with a predetermined space therebetween.

[0080] Fig. 23 shows another example of the rotational speed sensor device, comprising an encoder 3 made of a magnetic material and having lands and recesses circumferentially alternately arranged and a sensor 4 comprising a pair of Hall elements 140 arranged with a predetermined space therebetween and a permanent magnet 141. The Hall elements 140 are precisely posi-

tioned in a circumferential direction of the encoder 3.

[0081] In Fig. 24, the outputs  $f_1(t)$  and  $f_2(t)$  of the pair of Hall elements of the sensor 4 as shown in Figs. 73 and 74 change as shown by curves (A) and (B) corresponding to the rotation of the encoder 3.

[0082] Fig. 25 shows an output of the sensor 4 as shown in Figs. 22 and 23, which is the difference in output between the Hall elements as shown Curves (A) and (B) in Fig. 24. That is  $\{f_1(t) - f_2(t)\}$ . The output of the sensor 4 changes based on the phase difference  $\delta$  (Fig. 24) of the outputs  $f_1(t)$  and  $f_2(t)$  of the pair of the Hall elements. When the phase difference  $\delta$  is  $\pi$  radians (180degrees), the output of the sensor 4 is the largest. Thus, the pair of Hall elements 140 of the sensor 4 must be precisely arranged with reference to the circumferential direction of the encoder 3 to provide the space of  $\pi$  radians between the Hall elements to increase the output of the sensor 4. This is achieved by the present invention.

## Claims

1. A rolling bearing unit with a rotational speed sensor comprising:

a stationary ring (1) having an end and a first raceway (5a;5b),  
 a rotatable ring (2) having an end and a second raceway (8a;8b),  
 one of the stationary and rotatable rings (1,2) being an outer ring (1) and the other an inner ring (2),  
 a plurality of rolling elements (9) rotatably provided between the first and second raceways (8a,8b) to rotatably support the stationary and rotatable rings (1,2),  
 a sensor support case (129) having a step portion (41) for axial positioning, a detecting portion and a sensor mounted therein,  
 an encoder (3) having circumferentially changing magnetic characteristics, the encoder connected to the end of the rotatable ring (2),  
 a cover (18) made of a synthetic resin, the cover (18) connected to the end of the stationary ring (1) and having a fitting portion (29,36) coupled to the outer ring (1), the fitting portion (29,36) formed with a groove in which a seal ring (33) is mounted; a mount hole (38,44) spaced radially from a main axis of rotation of the bearing unit, the mount hole (38,44) receiving a cylindrical part (61) of the sensor support case (129) for mounting the sensor support case (129) in a position spaced radially from the main axis of rotation of the bearing unit, with a ring seal (42) mounted between the mount hole (38,44) and the sensor support case (129), a wall of the mount hole (38,44) and the sensor support

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case (129) having a cooperating groove and protrusion (171, 172), for positioning the sensor support case (129) in a circumferential direction, said groove and protrusion (171, 172) being located so that the angular orientation of the sensor support case (129) in the cover (18) is determined prior to the ring seal (42) sealing between the mount hole (38, 44) and the sensor support case (129) when the sensor support case (129) is being fitted to the cover (18); and a portion (44) against which the step portion (41) of the sensor support case (129) is abutted for axial positioning of the sensor support case (129),

an elastic member (47) having a first portion (49) engaged with the cover (18) and a second portion (50) engaged with the sensor support case (129) to fix the sensor support case (129) to the cover (18), and

wherein the detecting portion of the sensor is faced to the encoder (3) to output a frequency signal proportional to the rotational speed of the rotatable ring (2).

#### Patentansprüche

1. Rollenlagereinheit mit einem Drehzahlmeßfühler, die aufweist:

einen stationären Ring (1) mit einem Ende und einer ersten Laufbahn (8a; 8b);  
einen drehbaren Ring (2) mit einem Ende und einer zweiten Laufbahn (5a; 5b),

wobei einer von stationärem und drehbarem Ring (1, 2) ein Außenring (1) und der andere ein Innenring (2) ist;

eine Vielzahl von Rollenelementen (9), die drehbar zwischen der ersten und der zweiten Laufbahn (8a, 8b) vorhanden ist, um den stationären und den drehbaren Ring (1, 2) drehbar aufzunehmen;

ein Meßfühleraufnahmegehäuse (129) mit einem Stufenabschnitt (41) für eine axiale Positionierung, einem Nachweisabschnitt und einem darin montierten Meßfühler;

eine Kodiereinrichtung (3) mit sich peripher verändernden magnetischen Eigenschaften, wobei die Kodiereinrichtung mit dem Ende des drehbaren Ringes (2) verbunden ist;

eine Abdeckung (18) aus einem synthetischen Harz, wobei die Abdeckung (18) mit dem Ende des stationären Ringes (1) verbunden ist und aufweist: einen Montageabschnitt (29, 36), der mit dem Außenring (1) gekoppelt ist, wobei der Montageabschnitt (29, 36) mit einer Nut versehen ist, in

der ein Dichtungsring (33) montiert wird; ein Montageloch (38, 44), das radial von einer Hauptdrehungsachse der Lagereinheit beabstandet ist, wobei das Montageloch (38, 44) einen zylindrischen Teil (61) des Meßfühleraufnahmegehäuses (129) für ein Montieren des Meßfühleraufnahmegehäuses (129) in einer Position aufnimmt, die radial von der Hauptdrehungsachse der Lagereinheit beabstandet ist, wobei ein Dichtungsring (42) zwischen dem Montageloch (38, 44) und dem Meßfühleraufnahmegehäuse (129) montiert wird, wobei eine Wand des Montageloches (38, 44) und das Meßfühleraufnahmegehäuse (129) eine zusammenwirkende Nut und Vorsprung (171, 172) für das Positionieren des Meßfühleraufnahmegehäuses (129) in einer Umfangsrichtung aufweisen, wobei die Nut und der Vorsprung (171, 172) so angeordnet sind, daß die winkelige Ausrichtung des Meßfühleraufnahmegehäuses (129) in der Abdeckung (18) vor dem Abdichten zwischen dem Montageloch (38, 44) und dem Meßfühleraufnahmegehäuse (129) mittels der Ringdichtung (42) ermittelt wird, wenn das Meßfühleraufnahmegehäuse (129) an der Abdeckung (18) angebracht wird; und einen Abschnitt (44), an den der Stufenabschnitt (41) des Meßfühleraufnahmegehäuses (129) für ein axiales Positionieren des Meßfühleraufnahmegehäuses (129) anstößt;

ein elastisches Element (47) mit einem ersten Abschnitt (49), der mit der Abdeckung (18) in Eingriff kommt, und einen zweiten Abschnitt (50), der mit dem Meßfühleraufnahmegehäuse (129) in Eingriff kommt, um das Meßfühleraufnahmegehäuse (129) an der Abdeckung (18) zu befestigen, und worin der Nachweisabschnitt des Meßfühlers zur Kodiereinrichtung (3) hin liegt, um ein Frequenzsignal auszugeben, das der Drehzahl des drehbaren Ringes (2) proportional ist.

#### Revendications

1. Unité de palier à roulement comportant un capteur de vitesse de rotation, comprenant:

une bague stationnaire (1) comportant une extrémité et un premier chemin de roulement (8a; 8b),

une bague rotative (2) comportant une extrémité et un deuxième chemin de roulement (5a; 5b),

une des bagues stationnaire et rotative (1, 2) constituant une bague externe (1), l'autre constituant une bague interne (2),

plusieurs éléments de roulement (9) agencés

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par rotation entre les premier et deuxième chemins de roulement (8a, 8b) pour supporter par rotation les bagues stationnaire et rotative (1, 2),

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un boîtier de support du capteur (129) comportant une partie étagée (41) en vue du positionnement axial, une partie de détection et un capteur qui y est monté,

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un codeur (3) comportant des caractéristiques magnétiques à changement circonférentiel, le codeur étant connecté à l'extrémité de la bague rotative (2),

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un couvercle (18) composé de résine synthétique, le couvercle (18) étant connecté à l'extrémité de la bague stationnaire (1) et comportant une partie d'ajustement (29, 36) accouplée à la bague externe (1), la partie d'ajustement (29, 36) comportant une rainure dans laquelle est montée une bague d'étanchéité (33); un trou de montage (38, 44) espacé radialement d'un axe de rotation principal de l'unité de palier, le trou de montage (38, 44) recevant une partie cylindrique (61) du boîtier de support du capteur (129) pour monter le boîtier de support du capteur (129) dans une position espacée radialement de l'axe de rotation principal de l'unité de palier, un joint annulaire (42) étant monté entre le trou de montage (38, 44) et le boîtier de support du capteur (129), une paroi du trou de montage (38, 44) et du boîtier de support du capteur (129) comportant une rainure et une saillie de coopération (171, 172) pour positionner le boîtier de support du capteur (129) dans une direction circonférentielle, ladite rainure et ladite saillie (171, 172) étant agencées de sorte que l'orientation angulaire du boîtier de support du capteur (129) dans le couvercle (18) est déterminée avant l'établissement de l'étanchéité par le joint annulaire (42) entre le trou de montage (38, 44) et le boîtier de support du capteur (129) lors de l'ajustement du boîtier de support du capteur (129) sur le couvercle (18); et une partie (44) contre laquelle bute la partie étagée (41) du boîtier de support du capteur (129) en vue du positionnement axial du boîtier de support du capteur (129),

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un élément élastique (47) comportant une première partie (49) engagée dans le couvercle (18) et une deuxième partie (50) engagée dans le boîtier de support du capteur (129) pour fixer le boîtier de support du capteur (129) sur le couvercle (18), et

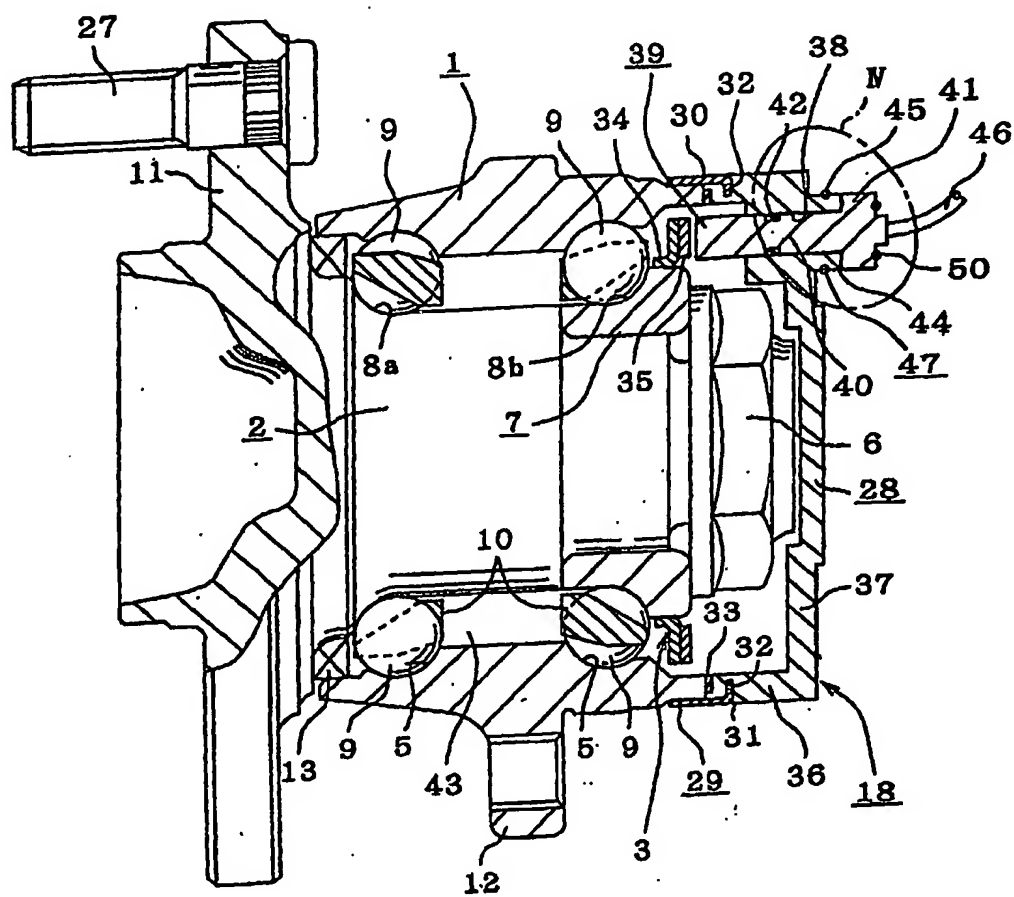
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la partie de détection du capteur faisant face au

codeur (3) pour émettre un signal de fréquence proportionnel à la vitesse de rotation de la bague rotative (2).

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Fig. 1



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Fig. 2

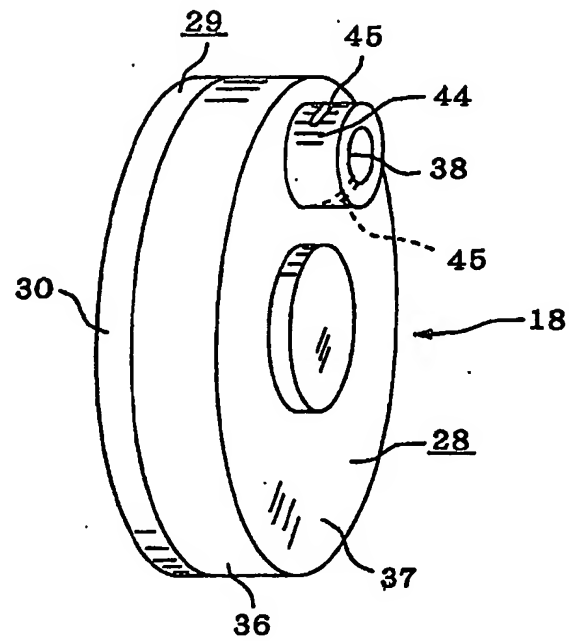
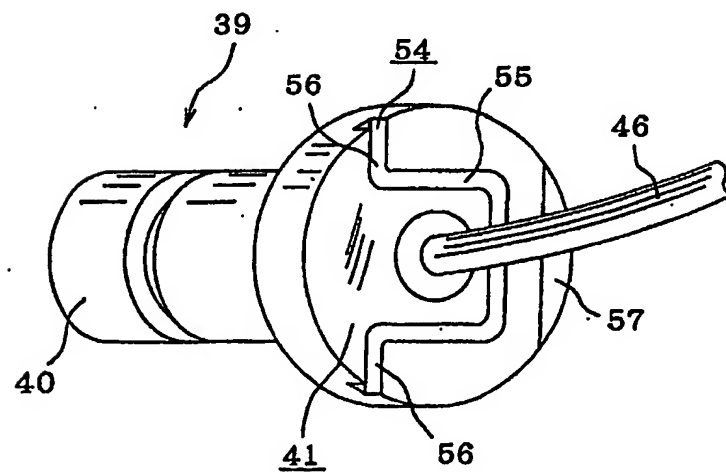


Fig. 3



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Fig. 4

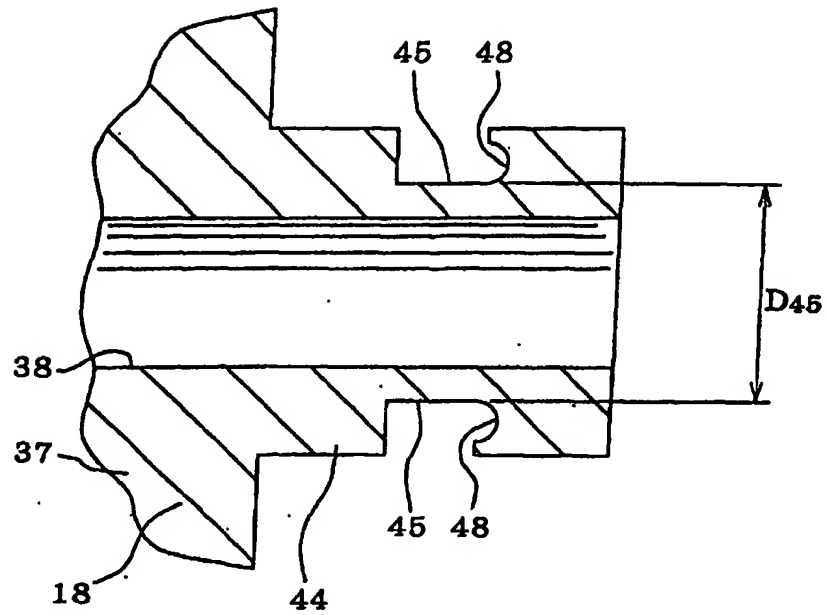
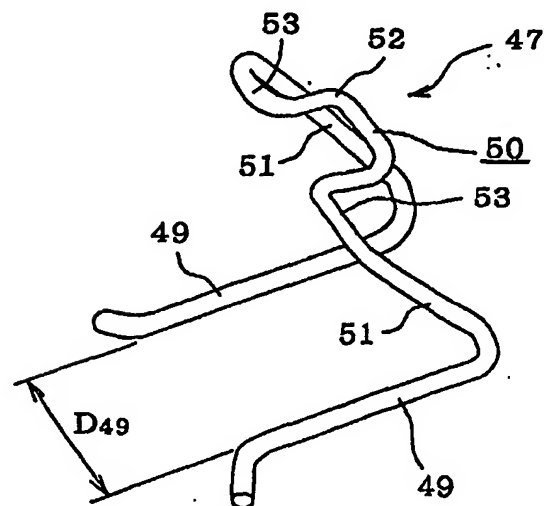
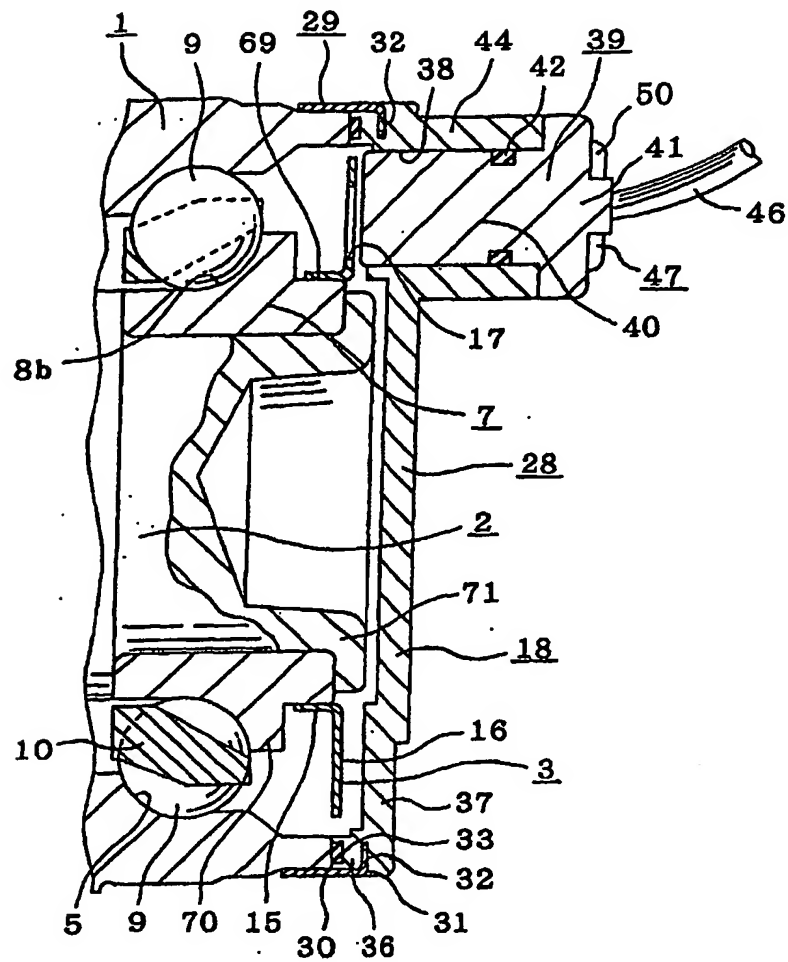


Fig. 5



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Fig. 6



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Fig. 7

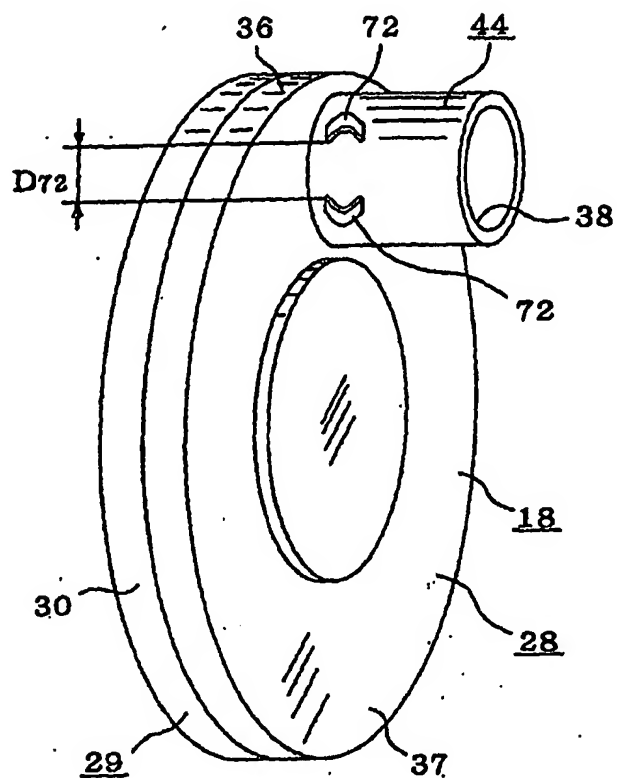
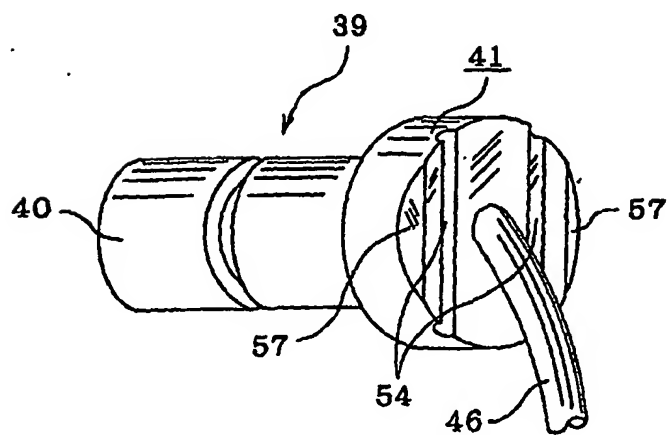


Fig. 8



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Fig. 9

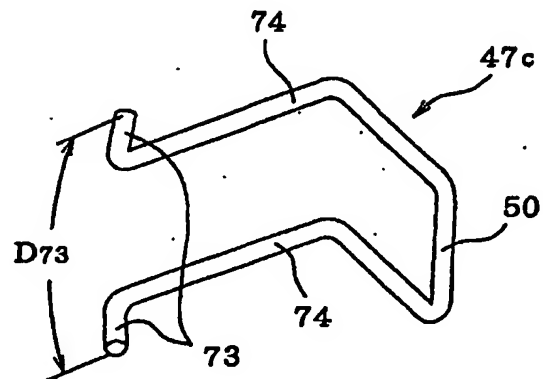
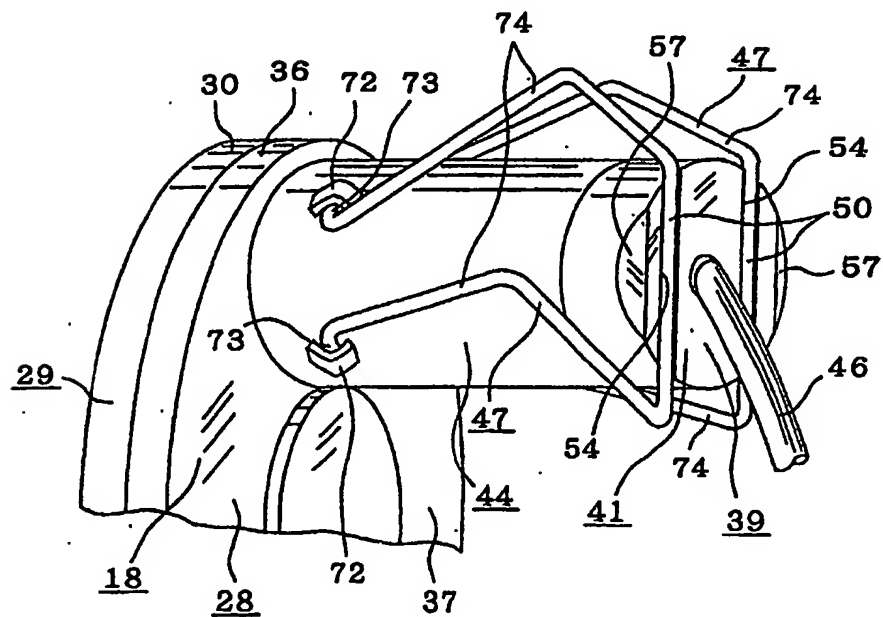
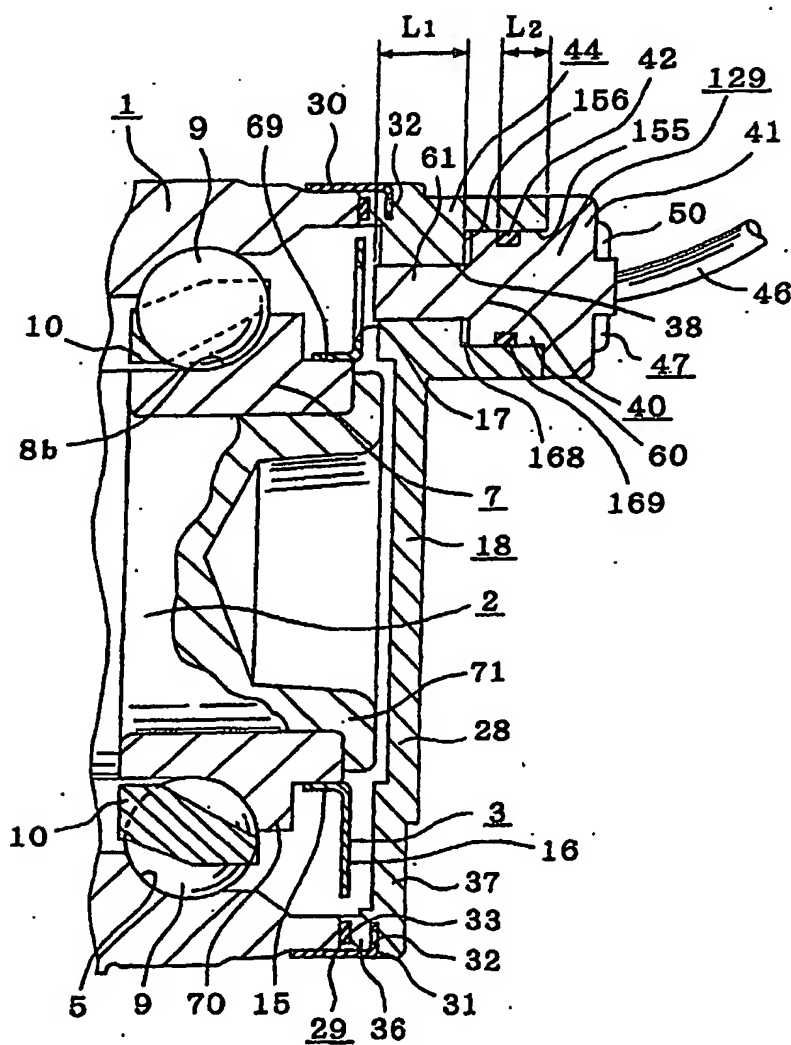


Fig. 10



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Fig. 11



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Fig. 12

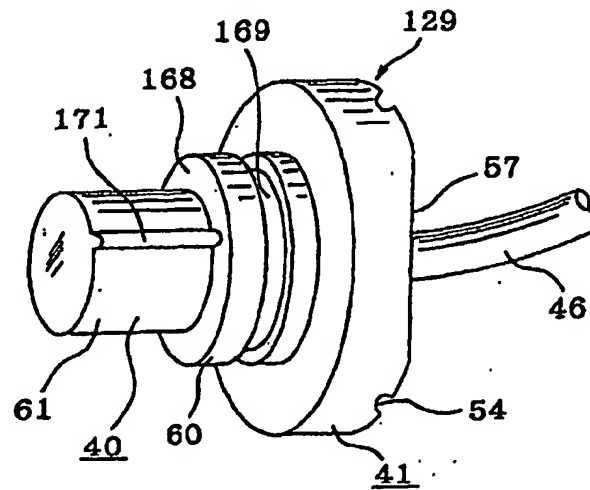
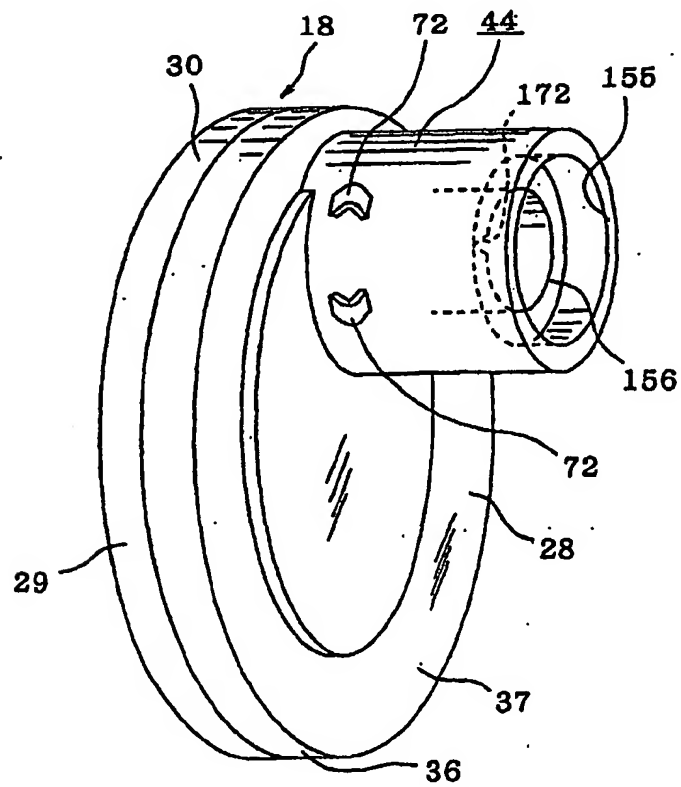


Fig. 13



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Fig. 14

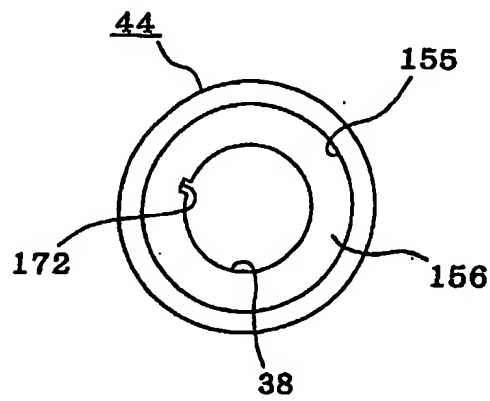
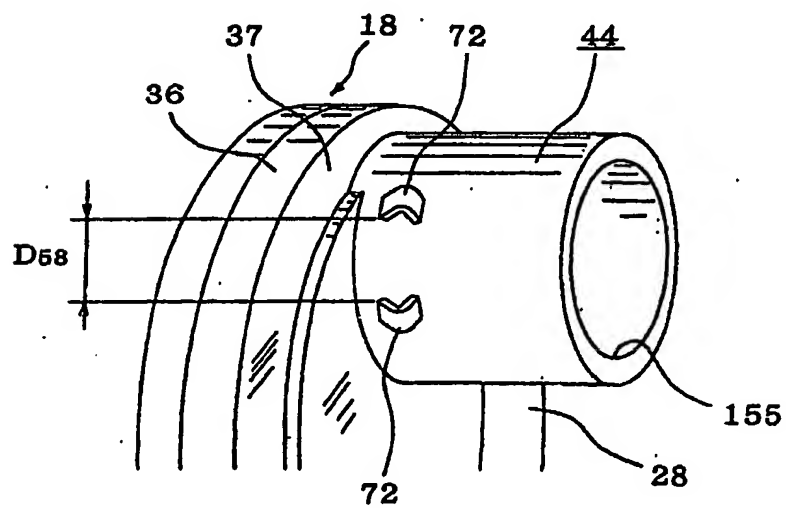


Fig. 15



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Fig. 16

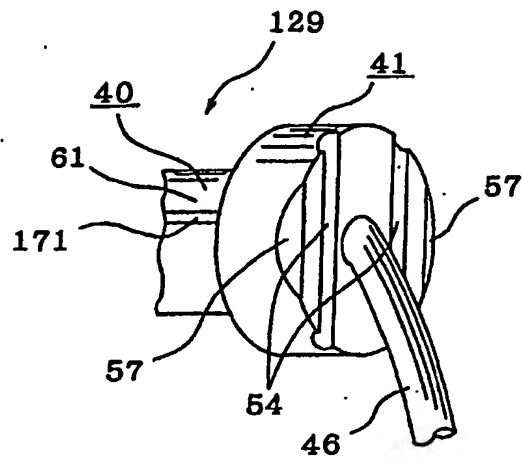
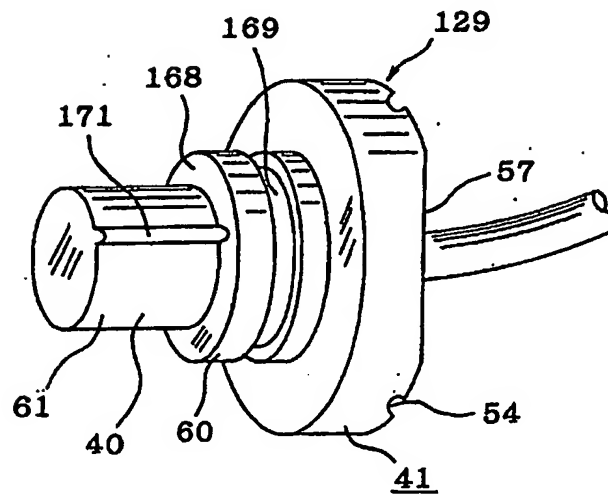


Fig. 17



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Fig. 18

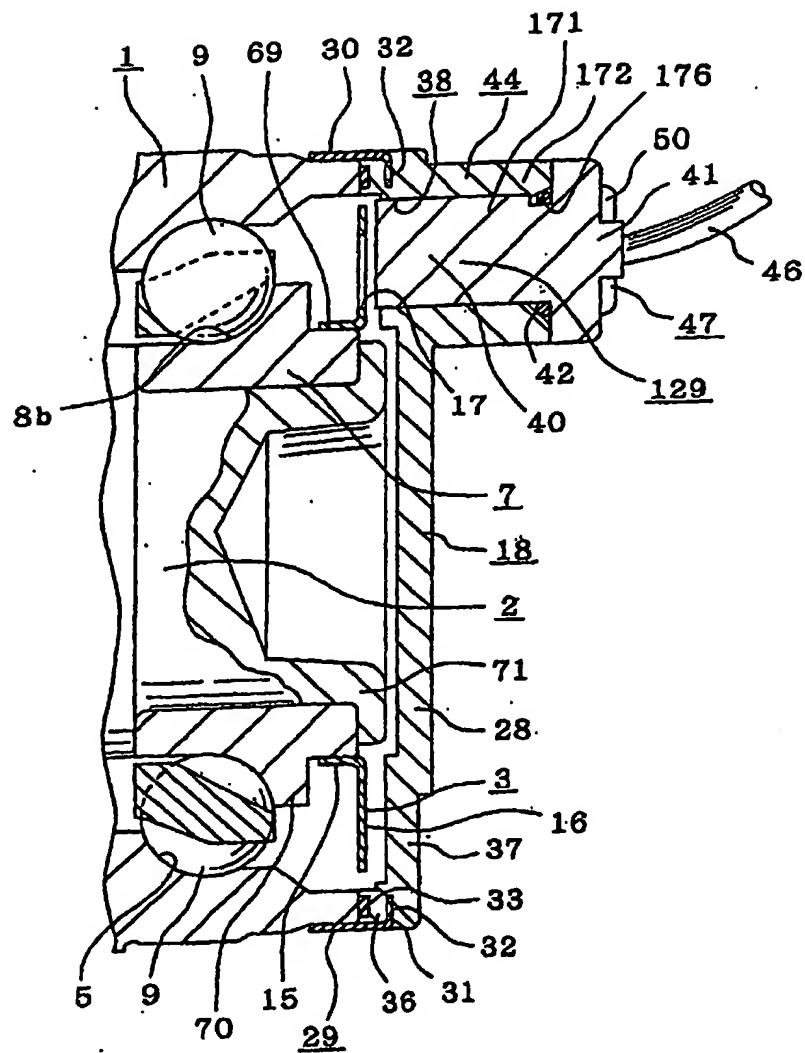
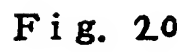
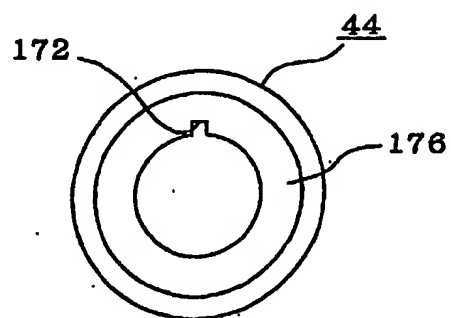


Fig. 19



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Fig. 21



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Fig. 22

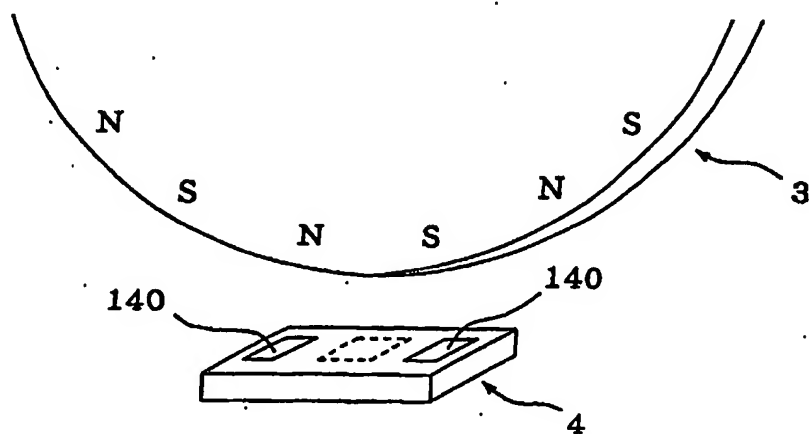
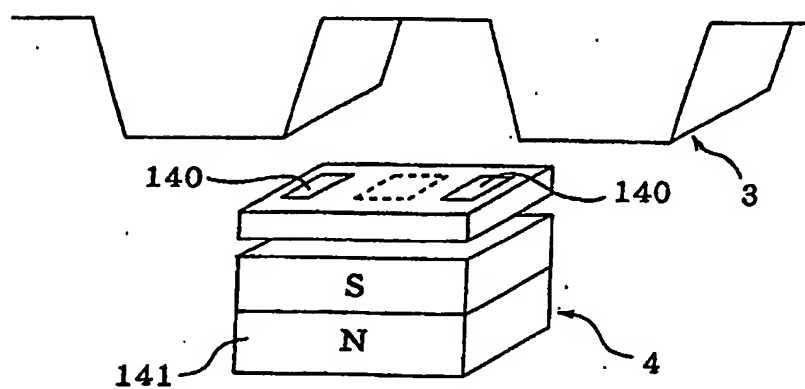


Fig. 23



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Fig. 24

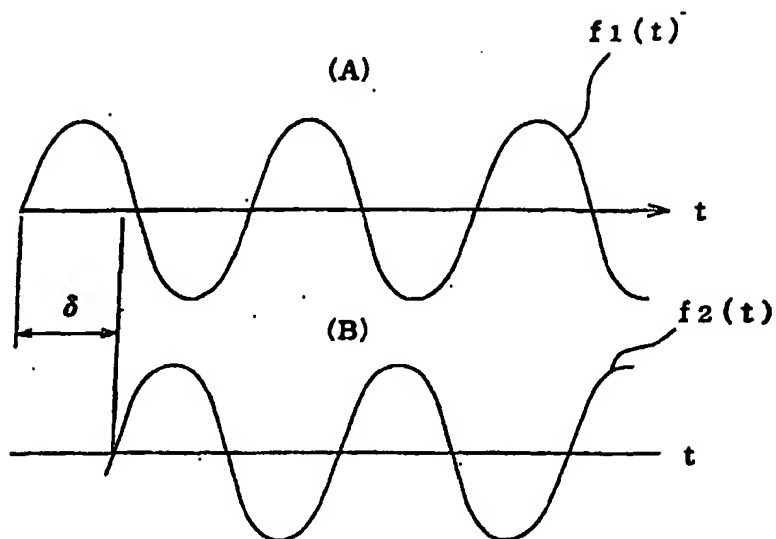


Fig. 25

